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## Coordination of Mesoscale Meteorological Research
## between ASL and European Groups

Principal Investigator : Professor R. P. Pearce

Contractor : University of Reading, U.K.

Contract Number : DAJA 45-90-C-0009

### SECOND INTERIM REPORT
### 1st April 1990 - 31st July 1990

The main activity during this period was the Meeting of the European
Mesometeorology panel along with members of ASL in Traben-Trarbach, West
Germany, 23rd - 27th April, 1990.    This report consists entirely of the
report of that meeting with its 10 recommendations.    These all refer to the
strengthening of the mesoscale modelling activity at ASL and exploitation of
the data from the project WIND.    The panel is most concerned that this most
excellent data set be made available, as soon as possible, to the    many
mesoscale modelling groups in the U.S. and Europe in order that all can
contribute to the development of mesoscale modelling at ASL for the benefit
of the U.S. Army.

Professor R. P. Pearce
27.06.90

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REPORT OF

U.S. ARMY ATMOSPHERIC SCIENCES LABORATORY

17th MEETING OF THE MESOMET ADVISORY PANEL

23 - 27 April, 1990

GMGO, TRABEN TRARBACH, FRG

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## SUMMARY OF RECOMMENDATIONS

R15: In keeping with recommendations made previously by the Panel it is strongly suggested that ASL continues to strengthen the meso-scale modelling group at ASL.

R16: The meso-scale model development at ASL should focus on the further development of one of the already existing and validated models.

R17: Cooperation with other modelling groups through contracts managed from ASL should continue to be pursued as an important means of providing the intellectual resources and the broad knowledge base necessary to ensure success for an Army meso-scale modelling programme. Every effort should be made to ensure that the programme has a clear, operational goal which can guide the contract work.

R18: The research focus of the 6.1 work should be on the routine exercising, specialized enhancement and development of understanding of the capabilities of the selected nested meso-scale and dispersion models.

The selected model should be in continuous use, for instance by running it in selected geographical areas on a six-hourly basis. Model performance should be evaluated through comparisons with observations and through comparisons with results from other models. It is suggested that an appropriate form of the model should be run on a semi-operational basis over a suitable area in Germany, where the terrain is varied and the observational network very dense.

R19 (see also R17):The development of meso-scale model, nested grid and dispersion modelling capabilities, should be the topic areas funded through an external contract programme.

R20: A workshop should be held in early 1992 to compare ASL model capabilities with those of other internationally recognized meso-scale and dispersion modelling groups.

R21: The technology transfer function of the 6.1 effort should be evaluated by its ability to provide modelling tools to the 6.2 effort which can be routinely exercised for any geographic area for any weather condition.

R22: Peer-reviewed publications directly related to the above recommendations should be a major evaluation criterion of the performance of the group.

R23: A full specification of the format of the data tapes for project WIND should be made available to the panel before the proposed December 1990 meeting, together with details of the subsects to be distributed to workshop participants.

R24: The Panel recommends that an informal information sheet be distributed by the 6.1 and 6.2 groups at perhaps quarterly intervals in order to communicate progress and accomplishments to the Panel and other interested parties. This work should summarize both in-house and contractual work, in progress and projected.

# 1. THE PANEL PROGRAMME

This meeting was arranged with the primary purpose of informing the Panel members of work carried out at ASL over the past year under both the 6.1 and 6.2 programmes and for obtaining their advice on various aspects arising from the much more closely integrated approach now being undertaken in the two divisions. The meeting thus took the form of a scientific conference including several technical presentations as well as Panel Meetings. The list of participants is given in Appendix 1 and the Agenda in Appendix 2.

Section 2 of the Report contains the Panel's reactions to the developments at ASL over the past year and Section 3 comments on ASL's future plans in both the short- and long-terms. Section 4 is concerned with the future activities of the Panel, in particular, its involvement in special projects and its support of modelling activities at ASL.

# 2. DEVELOPMENTS AT ASL SINCE APRIL 1989

During the first three days of the meeting the Panel were informed of developments there in both the 6.1 and 6.2 groups over the past year. The 6.2 presentations were essentially updates of those made at its meeting at NMSU in April 1989 and the Panel much welcomed these presentations and were impressed with the steady progress made. The programme as a whole indicated a strong focus and continuity. It looked forward to an opportunity to discuss these projects in more detail with the individual scientists concerned at its next meeting at ASL.

The 6.1 programme, particularly those aspects concerning modelling and the WIND project data set, had been extensively examined at its last meeting and led to the formulation of several strong recommendations.

The Panel was informed by Doug Brown on the actions taken by ASL on these recommendations. The Panel acknowledges his report and comments on it as follows (the notation follows that of the last year's Panel Report):

> R1: Since it does not seem feasible to create an academic position at NMSU a good alternative is to create close links between ASL and the Army Centre at CSU, especially with its modelling group.

> R2 - R4: The Panel noted with satisfaction that the work on SIGMET has been continuously phased out. The interim mesoscale model by the NAVY is going to replace SIGMET within the next year or so. Since none of the Panel members is familiar with its details, the Panel requests the relevant information on this model.

> R5: The Panel noted also with satisfaction that Ron Meyers was made responsible for the implementation and maintenance of the new model. The remark made under R1 is of special relevance here.

> R6: The multi-scale approach envisaged for the future work relates directly to this recommendation.

R7: Since the USAF unfortunately discarded the possibility of assigning a Staff Weather Officer to ASL the Panel suggests the possibility be explored of assigning a NAVY officer-scientist to ASL, who is familiar with the NAVY mesoscale model. Such a measure would speed up the implementation of the model and would also create possibilities to verify and improve this model.

R8 - R9: The nested-grid approach of the interim model provided for the near future makes these recommendations in all likelihood obsolete. The multi-scale, adaptive grid scheme envisaged in the long term strategy does that even more so.

R10 - R13: These recommendations dealt with the WIND data base. The Panel noted with satisfaction that the task of finalizing the data base was given to Ron Cionco, whose expertise in both data management and canopy research is well recognised by the Panel. The Panel repeats the recommendation to bring the WIND data base to the scientific community at the earliest possible date in order to exploit to the full its uniqueness in the mesoscale area.

R14: Since the Panel did not have the opportunity to visit ASL in late 1989 this recommendation is repeated.

### 3. FUTURE DEVELOPMENTS IN MESO-SCALE MODELLING AT ASL

#### a. OVERALL STRATEGY

The Panel continues to believe that it is of great importance to the Army to have strong R&D efforts in the area of meso-scale modelling. The reasons for this are several. Maybe the most important general argument in support of an Army meso-scale modelling programme is the central role which such a programme would play in guiding the transfer of technology - hardware as well as software - from research efforts going on elsewhere to the Army's application-oriented activities. The Panel views the work of the 6.2 sections, as applications development and that of the 6.1 sections as applied research rather than basic or long-term research.

The Panel finds that the Army would benefit from a well-focused meso-scale modelling effort through the understanding of meso-scale meteorology, which would be the result of continuous work with meteorological interpretations of model outputs and their comparison with observations. Further improvement of the representation in the models of the physics together with improvements in the numerical efficiency of the models will, with considerable certainty, lead to better models which can run operationally on transportable computer systems compatible with field requirements.

The Panel is concerned that the meso-scale modelling group at ASL may not gain "critical mass". The Panel acknowledges the quality and originality of much of the work reported to it, but the Panel encourages that the focus be sufficiently sharp and resources be made available sufficient for the work to become really successful, both in academic terms and in terms of Army applications.

The Panel has noted with interest and approval that the meso-scale modelling group at ASL associates itself with several competent scientific groups in the U.S. and abroad and that it manages a considerable portfolio of

contracts. Many of these groups, e.g. that at CSU, carry out basic research
of high quality and it is by establishing such links with them that the group
at ASL is able to ensure that the results are adapted in the most effective
way to the Army's needs.

Furthermore the Panel has reviewed the ideas behind the hierarchy of models
(SIGMET, VARYME, HRW, CANOPY) which hitherto has constituted the background
for the modelling efforts at ASL. The Panel agrees that the hierarchal
approach should be abandoned in favour of a nested grid approach and concurs
with Ron Meyers' point of view that such a nested grid approach appears to be
a fruitful one.

#### Recommendations

R15: In keeping with recommendations made previously by the Panel it is
strongly suggested that ASL continues to strengthen the meso-scale
modelling group at ASL.

R16: The meso-scale model development at ASL should focus on the further
development of one of the already existing and validated models.

R17: Cooperation with other modelling groups through contracts managed
from ASL should continue to be pursued as an important means of
providing the intellectual resources and the broad knowledge base
necessary to ensure success for an Army meso-scale modelling programme.
Every effort should be made to ensure that the programme has a clear,
operational goal which can guide the contract work.

b. FOCUS OF THE 6.1 GROUP

The leadership of the 6.1 effort by Ron Meyers offers an opportunity to
enhance ASL involvement in the meso-scale and atmospheric dispersion
modelling community. Since he has only recently undertaken this
responsibility, however, it is premature to assess the progress, under his
direction, of the newly configured 6.1 group towards effective technology
transfer of meso-scale and atmospheric dispersion modelling capability to the
6.2 effort.

Other recommendations on this topic are:

#### Recommendations

R18: The research focus of the 6.1 work should be on the routine
exercising, specialized enhancement and development of understanding of
the capabilities of the selected nested meso-scale and dispersion
models.

The selected model should be in continuous use, for instance by running
it in selected geographical areas on a six-hourly basis. Model
performance should be evaluated through comparisons with observations
and through comparisons with results from other models. It is
suggested that an appropriate form of the model should be run on a
semi-operational basis over a suitable area in Germany, where the
terrain is varied and the observational network very dense.

R19 (see also R17):The development of meso-scale model, nested grid and
dispersion modelling capabilities, should be the topic areas funded
through an external contract programme.

R20: A workshop should be held in early 1992 to compare ASL model capabilities with those of other internationally recognized meso-scale and dispersion modelling groups.

R21: The technology transfer function of the 6.1 effort should be evaluated by its ability to provide modelling tools to the 6.2 effort which can be routinely exercised for any geographic area for any weather condition.

R22: Peer-reviewed publications directly related to the above recommendations should be a major evaluation criterion of the performance of the group.

c.   THE PROPOSED MODEL INTERCOMPARISON WORKSHOP (see R20)

The Panel concurs with ASL's suggestion that other models be tested using the WIND I data base.   The Panel expands that suggestion by recommending that a multi-model intercomparison be made at a workshop in April 1992. Participation in the workshop would be by invitation.   As general criteria, models having the following features should be considered: non-hydrostatic, terrain, moisture and cloud parameterizations.   Candidate models include those developed in Europe by Dr. Gross, GMGO, France, Britain, Israel (Alpert) and in America by Army, Navy, Air Force, Penn State/NCAR, Colorado State, University of Oklahoma, UCLA and Los Alamos (T. Yamada).   The participating modellers would be asked to simulate a 24 hour period of the WIND (Phase I) and WIND (Phase III) to provide a range of conditions.   It is anticipated that Phase I data will be available, with documentation, by 12/90;  Phase III data by 10/91.

To accomplish the intercomparison a set of objective evaluation criteria should be developed by the Panel and ASL by the conclusion of the next Panel meeting.   Funding for this activity would be partially achieved through Panel "special project" funds.   Additional funding for the workshop will be sought through DoD or other agency funds.

d.   ASL's RECOMMENDATIONS FOR THE PANEL's INVOLVEMENT IN ITS PROGRAMME

Dr. Sutherland presented the following six recommendations to the Panel for their consideration and possible implementation:

(i)    To compare the UKMO and RAMS model performances using Phase I WIND data.

(ii)   To suggest criteria for evaluating model performance.

(iii)  To deliver the UKMO model, Gross model and Porton Centre data to ASL.

(iv)   To review meso-scale model numerics.

(v)    To report AMADEUS T and D results to ASL.

(vi)   To provide data from European Air pollution events for Dr. Holt.

The Panel's reactions to these recommendations were:

(i)  Some progress had already been made in examining the UKMO model's
     performance using WIND Phase I data under an earlier contract (see
     Final Technical Report on Project WIND - Experiments with the U.K.
     Meteorological Office Meso-scale Model.    June 1989 - Contract
     DAJA45-87-C-0035).   This work had been useful in highlighting the
     importance of the model's accurate representation of land surface
     processes and radiation.    Future comparison with other models,
     including ASL's interim model, should certainly be carried out
     using the WIND data and these should form the focus of a workshop
     at ASL in April 1992.    (see recommendation R20 and paragraph c
     above).

(ii)  Suggested evaluation criteria are set out in paragraph e below.

(iii)  The UKMO model has already been delivered to Dr. Lilly at NCAR and
       there should be no difficulty in arranging for him to make a copy
       for ASL.    Dr. Gross would be willing to let ASL have a copy of his
       model and visit them to run and test it there on WIND data.
       Dr. Jones would attempt to arrange for the Porton data to be
       provided to ASL.

(iv)  The Panel agreed that a summary of existing modelling and
      dispersion modelling numerical procedures would form a significant
      contribution to model engineering.    It could use a small part of
      its "special project" funding to support a consultant to carry out
      this work.    In this context, it considered that any effort which
      ASL itself devoted "in-house" to developing numerical procedures
      should be expected to lead to peer-reviewed publications.

(v)  Dr. Busch agreed to pass on this request to Dr. Mikkelson at Risø.

(vi)  Mr. Comati agreed that this request could most appropriately be
      dealt with through his office.

e.   CRITERIA FOR MODEL EVALUATIONS

(i)     Model Evaluations

-    comparison of the model against observational data sets

-    comparison of simplified versions of the model with analytic theory

-    comparison of the model results with those of other models

-    evaluation of the mass, energy and moisture budgets in the model

-    availability of documented programmed logic for the model;

these should lead to

-    publications describing uses of the model in peer-reviewed
     scientific journals.

(ii)     Model Capabilities

-    Existing linkage of the meteorological model to Lagrangian
     dispersion model and advection-diffusion models

-    ability of the model to telescope downwards in scale to small-scale
     regimes of interest

-    ability of the models to simulate the range of observable
     meteorological conditions found anywhere in the world

-    ability of the meteorological model to be initialized from synoptic
     model predictions

-    ability of the dispersion model to simulate chemical
     transformations, radioactive decay and wet and dry deposition.

## 4.    FUTURE ACTIVITIES OF THE PANEL

The new contract with Reading University under which the Panel is now funded
covers two meetings at ASL during the period October 1990 - 30 September
1992.    In addition it includes funds for special projects amounting to
$40,000 over the period 1 February 1990 - 30 September 1992.    The Panel
proposes that the main part of this special project money be used to support
European meso-scale modelling groups in contributing to the model comparison
project leading to the proposed workshop at ASL in April 1992.    The precise
level of support will need to be determined when the number of participating
groups from Europe is known, but is likely to be not more than $5,000 per
group.    The groups will themselves be expected to contribute to the costs of
their participation, but other sources of funding will be sought.

It suggests that the next Panel meeting be held at ASL during the week 3-7
December 1990, with the main purpose of (1) acquainting members with projects
being undertaken in Dr. Niles' section (6.2) and (2) arranging full details
for the 1992 model comparison workshop, including specifications of model
runs required and evaluation criteria.    By that time those groups agreeing
to participate will be known and they will require to be informed in full
detail of the work they will be expected to carry out.

The second Panel meeting at ASL will be arranged to be held in conjunction
with the 1992 workshop.

### Recommendations

R23: A full specification of the format of the data tapes for project
WIND should be made available to the panel before the proposed December
1990 meeting, together with details of the subsects to be distributed to
workshop participants.

R24: The Panel recommends that an informal information sheet be
distributed by the 6.1 and 6.2 groups at perhaps quarterly intervals in
order to communicate progress and accomplishments to the Panel and other
interested parties.    This work should summarize both in-house and
contractual work, in progress and projected.

APPENDIX 1.

# LIST OF PARTICIPANTS

1. **PANEL MEMBERS**

   Professor Robert Pearce, University of Reading, U.K.
   Dr. Walter Bach, Army Research Office, Durham, NC.
   Dr. Niels Busch, Risø Nat. Lab., Roskilde, Denmark.
   Professor Werner Klug, Technische Hochschule Darmstadt, FRG.
   Professor Emeritus Jehuda Neumann, University of Copenhagen, Denmark.
   Dr. Peter White, U.K. Met. Office, Bracknell, U.K.
   Professor Roger Pielke, C.S.U., Fort Collins, CO.

2. **OTHER OVERSEAS PARTICIPANTS**

   Dr. Chris Jones, Chemical Defense Establishment, Porton, U.K.
   Dr. Gunther Gross, Technische Hochschule Darmstadt, FRG.

3. **ASL MANAGERS**

   Mr. Gene Morris, Technical Director.
   Dr. Frank Niles, Director, Atmospheric Effects Division (AED)
   Dr. Bernard Engebos, Chief, Intelligence and Chemical Branch (AED)
   Dr. Doug Brown, Director Atmospheric Research Division (ARD)
   Dr. Bob Sutherland, Chief, Meteorology and Observations Branch (ARD)

4. **ASL PRESENTERS**

   Mr. Ron Meyers
   Dr. Donna Tucker
   Mr. Jim Harris

5. **US ARMY EUROPEAN RESEARCH OFFICE**

   Mr. Jerry Comati

6. **GMGO**

   Professor Aufm Kampe

Appendix 2.

## AGENDA

**MESOMET ADVISORY PANEL CONFERENCE**
Traben Trabach, FRG
23-27 April 1990

**DAY-1**          (Monday, 23 April, 1990)

0930-1000:    CHECK IN & INTRODUCTIONS

    1000-1130:**OPENING SESSION**   (Chair, Mr. Morris)

1000-1030:    Host Briefing & Welcome                       Prof. Klug

1030-1100:    Overview & Objective                          Mr. Morris

1100-1130:    ASL Implementation of Panel Recommendations
                 from the April '89 Las Cruces Conference    Dr. Brown

1130-1200:    Discussion                                    All

1200-1330:    LUNCH

    1330-1430:**TECHNICAL SESSION #1**   (Chair, Dr. Brown)

1330-1430:    Overview of ASL Restructured Modelling Approach
                                       Dr. Sutherland

1430-1500:    Discussion                                    All

1500-1530:    BREAK

1530-1630:    **CLOSED PANEL SESSION**                      Panel Members

--------------------------------END OF DAY 1--------------------------------

**DAY-2**          (Tuesday, 24th April, 1990)

    0900-1000:**TECHNICAL SESSION #2**   (Chair, Dr. Brown)

0900-1000:    Status of Multi-scale modelling at ASL and Project
                WIND Update                                   Mr. Meyers

1000-1030:    BREAK

    1030-1430:**TECHNICAL SESSION #3**   (Chair, Dr. Sutherland)

1030-1130:    Atmospheric Simulation Modelling at ASL     Mr. Meyers

1130-1300:    LUNCH

**DAY-2**   (cont'd....)

1300-1330:      Atmospheric Simulation Modelling at ASL (continued)
                                                              Mr. Meyers

1330-1400:      Discussion                              All

1400-1430:      Modelling Activities for Universities Research
                Initiative (URI)                        Dr. Pielke

    1430-1600:**TECHNICAL SESSION #4**   (Chair, Dr. Brown)

1430-1500:      Overview Chronology & Rationale of 6.2 Modelling
                Work                                    Dr. Niles

1500-1530:      BREAK

1530-1600:      Recent Developments at GMGO             Prof. Aufm Kampe

1600-1700:      ***CLOSED PANEL SESSION***              Panel Members

--------------------------------END OF DAY 2--------------------------------

**DAY-3**        (Wednesday, 25 April, 1990)

    0900-1130:**TECHNICAL SESSION #4**   (Chair, Dr. Niles)

0900-0945:      Mesoscale Nowcasting                    Dr. Tucker

0945-1000:      Goal-Oriented Pattern Detection (GOPAD)  Dr. Engebos

1000-1030:      BREAK

1030-1100:      Status of IMETS                         Mr. Harris

1100-1115:      Status of Aviation Model                Dr. Tucker

1115-1130:      Update of URI Program and ARO Support   Dr. Bach

1130-1300:      LUNCH

1300-1330:      Discussion, How to get from Research Models
                to Field Predictions                    All

1330-1400:      Overall ASL Programme                   Mr. Morris

1400-1600:      GMGO Presentations                      Prof. Aufm Kampe
                                                        and other GMCO
                                                        personnel

--------------------------------END OF DAY 3--------------------------------

**DAY-4**          (Thursday, 26 April, 1990)

   0900-1330:**TECHNICAL SESSION #5**   (Chair, Professor Pearce)

0900-1000:     Mesoscale Model Developments at University
               of Darmstadt                              Dr. Gross

1000-1030:     BREAK

1030-1100:     Mesoscale Model Developments at Meteorological
               Office                                     Dr. White

1100-1130:     The University of Reading/Meteorological Office
               Joint Mesoscale Modelling Centre           Prof. Pearce

1130-1300:     LUNCH

1300-1330:     Smoke Dispersion Field Experiments at Porton
               Down, U.K.                                 Dr. Jones

1330-1630:     **CLOSED PANEL SESSION**                   Panel Members


------------------------------END OF DAY 4------------------------------


**DAY-5**          (Friday, 27 April, 1990)

*0830-1030:*     **CLOSED PANEL SESSION**                 Panel Members

1030-1200:     **WRAP-UP SESSION & FEEDBACK** (Prof. Pearce)   Panel Members
                                                          Mr. Morris
                                                          Dr. Brown
                                                          Dr. Niles

1200:          MEETING ADJOURNED


------------------------------END OF DAY 5------------------------------